Impact of Inadequate Sleep on Adolescent Health

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Isn't Adolescence our Healthiest Age?

Why Care?
Why Care?

• Adolescent health affects adult health
  – Adolescent onset of mental health conditions
  – High school impacts long-term finances & health
  – Lifestyle factors crystallize during adolescence
  – Adolescent obesity → adult obesity-related complications, even after weight loss
    (e.g., Must et al., 2002; Power et al. 1997)

• Prevention efforts challenging in teens
  – Overall effect of obesity prevention <0.1 BMI unit.
    (Waters et al., 2011)

Why Care?

• Healthcare costs are huge
  – $2.6 Trillion in 2010

Federal Outlays for - FY 2012

- Health Care 23%
- Pensions 23%
- Interest 6%
- Other Spending 4%
- General Government 1%
- Transportation 3%
- Protection 2%
- Welfare 12%
- Defense 24%

(www.USgovernmentspending.com)
Why Care?

• Healthcare costs are huge and growing.

Why Care?

(Special “shout-out” to the educators)

• Health needed to learn
• Health promotion programs directly involve schools
• Objections to public policy that promotes teen sleep come from people who are interested in health
Inadequate sleep causes real-world problems:

**Mental Health**
- Daytime sleepiness
- Attention & Learning
Sleep and Health Outcomes

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**Physical Health**
- Obesity
- Athletics
- Illness
- Special Populations

**Short Sleep & Obesity:**
Real-World Evidence

(Beebe et al., 2007)
Short Sleep & Obesity: 
Real-World Evidence

(Cappucio et al., 2008)

Short Sleep & Obesity: 
Evidence of Causation

Sleepy Teens Study
### Sleepy Teens Study

<table>
<thead>
<tr>
<th>Mon – Fri nights</th>
<th>Sat-Sun nights</th>
<th>Mon – Fri nights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sleep Restriction</strong></td>
<td>(self-selected bedtime)</td>
<td><strong>Healthy Sleep Duration</strong></td>
</tr>
<tr>
<td>(bedtime set to allow 6.5 hours/night in bed)</td>
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Short Sleep & Obesity: Evidence of Causation

Sleepy Teens Study

Average Sleep Schedules

<table>
<thead>
<tr>
<th>Time</th>
<th>Sleep Dep.</th>
<th>Healthy Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 PM</td>
<td>6.3 hr</td>
<td>8.8 hr</td>
</tr>
</tbody>
</table>

24-hour Dietary Recall, Sleepy Teens Study

<table>
<thead>
<tr>
<th>Calories</th>
<th>SR (1953)</th>
<th>HS (1796)</th>
</tr>
</thead>
</table>

$t(40) = 1.32, p = .098$

(Beebe et al., 2013)
Short Sleep & Obesity: Evidence of Causation

24-hour Dietary Recall, Sleepy Teens Study

(Bbeebe et al., 2013)
Short Sleep & Obesity: Evidence of Causation

24-hour Dietary Recall, Sleepy Teens Study

![Graph showing correlations between sleep duration and dietary intake categories.](Beebe et al., 2013)

Short Sleep & Obesity: Evidence of Causation

Ratings of Appeal, Sleepy Teens Study

![Graph showing effect sizes for different food categories.](p < .05, p > .10, p > .20)
Sleep & Athletics: Real-World Evidence

• Short sleep is associated with certain types of sports injuries in youth. (Luke et al., 2011)

• Even among elite teen athletes, less sleep is associated with less willingness to train hard. (Engle-Friedman et al., 2010)

Sleep & Athletics: Evidence of Causation

(Mah et al., 2011)
Sleep & Athletics: Evidence of Causation

Throwing Accuracy

\[ p < .05 \]

Endurance (Steps)

\[ p < .05 \]

(Copes & Rosentswieg, 1972)

Sleep & Illness: Real-World Evidence

Hours of Sleep on School Nights

Missed/Sick Days in Past 2 Weeks

\[ p < .05 \]

(Wahlstrom, 2002)
**Sleep & Illness:**
Real-World Evidence

- Missed/Sick Days in Past 2 Weeks
- ~1/4 day every 2 weeks = 5 days every year
- p < .05

(Spigel et al., 2002)
Sleep & Illness: Evidence of Causation

(Spiegel et al., 2002)
Sleep & Looking Unwell: Evidence of Causation

(Axelsson et al., 2010)

Sleep & Special Populations: Active Investigations

- **Asthma** (L Meltzer): Sleep dep induces inflammation; does it make asthma worse?
- **Chronic Pain** (T Palermo, T Ward): does sleep dep worsen pain via inflammation or impairment via reduced pain threshold?
- **Diabetes**: (M Perfect): Sleep dep alters glucose regulation and may alter medical adherence; does it make diabetes worse?
Sleep and Health Outcomes

It’s time for some real-world solutions.

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Co-Investigators, Consultants

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- Ron Dahl, MD
- Steven Daniels, MD, PhD
- Mark DiFrancesco, PhD
- Sean Drummond, PhD
- Jeff Epstein, PhD
- David Gozal, MD
- Dennis Molfese, PhD
- M. Douglas Ris, PhD
- Douglas Rose, MD

Recent Co-Conspirators:

- >12 graduate students & fellows
- 2 year-round research assistants
- >40 summer research assistants
- 6 fMRI technicians
- 9 EEG technicians
- 2 study physicians

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